EnterMedSchool.org

Molecular Biology: Central Dogma

Printable Flashcards — Pre-Med Biology

DNA → RNA → Protein. Transcription, translation, genetic code, RNA processing, and gene regulation.

211 cards — Print double-sided, flip on long edge, then cut along dashed lines.

1

Central dogma in one line:
information usually flows from...

2

Transcription vs translation: what's the difference?

3

Gene expression basically means...

4

Trap: every gene makes a protein. True or false?

5

DNA is mainly for... and proteins are mainly for...

6

If a cell wants MORE of a protein,
the fastest lever is usually to...

7

DNA vs RNA: 2 easiest differences to remember.

8

RNA is usually single-stranded.
Why does that matter?

2

Transcription: DNA -> RNA.
Translation: RNA -> protein.

1

DNA -> RNA -> protein.

4

False.

3

Using a gene to make a functional
product (usually a protein).

6

Make more mRNA (increase transcription)
or translate more of the mRNA.

5

DNA stores information; proteins
do most of the work in cells.

8

It can fold into shapes and act
as a messenger/helper molecule.

7

DNA has deoxyribose + T; RNA has ribose + U.

9

Where does DNA -> RNA
(transcription) happen in eukaryotes?

10

Where does RNA -> protein
(translation) happen in eukaryotes?

11

Prokaryote bonus: transcription
and translation can happen...

12

The 'alphabet' of DNA is...

13

The 'alphabet' of RNA is...

14

Codon means...

15

Anticodon means...

16

The genetic code is described
as 'degenerate'. That means...

10

At ribosomes in the cytoplasm (or on rough ER).

9

In the nucleus.

12

A, T, C, G.

11

At the same time (coupled).

14

A 3-base sequence on mRNA that codes for an amino acid (or stop).

13

A, U, C, G.

16

Multiple codons can code for the same amino acid.

15

A 3-base sequence on tRNA that pairs with an mRNA codon.

17

But the genetic code is
NOT 'ambiguous' because...

18

Central dogma: DNA ->
{{c1::RNA}} -> {{c2::protein}}.

19

Transcription = DNA -> {{c1::RNA}};
translation = RNA -> {{c2::protein}}.

20

The molecule that carries the
message from DNA to ribosomes:

21

The RNA that brings amino acids to the ribosome:

22

The RNA that forms the core of ribosomes:

23

DNA strands are antiparallel. That means...

24

Polymerases add nucleotides to the... end.

18

Central dogma: DNA -> RNA -> protein.

17

Each codon specifies only one amino acid (or stop).

20

mRNA

19

Transcription = DNA -> RNA;
translation = RNA -> protein.

22

rRNA

21

tRNA

24

3' end.

23

One runs 5'->3' and the other runs 3'->5'.

25

So new DNA/RNA is
synthesized in which direction?

26

To synthesize 5'->3', the polymerase
must READ the template...

27

In transcription, which DNA
strand is used as the template?

28

The mRNA sequence is
complementary to the... strand.

29

The mRNA sequence matches
the... strand (except U for T).

30

Quick rule: coding strand vs template strand.

31

DNA base pairing: A pairs
with... and C pairs with...

32

RNA base pairing with DNA during
transcription: A pairs with...

26

3' -> 5'.

25

5' -> 3'.

28

Template strand.

27

The template (antisense) strand.

30

Coding = same as mRNA (T->U swap).
Template = complementary to mRNA.

29

Coding (sense) strand.

32

U (in RNA).

31

T; G.

33

Trap: RNA polymerase needs a primer like DNA polymerase. True or false?

34

Promoter is basically...

35

Trap: the promoter gets transcribed into mRNA. True or false?

36

Terminator is basically...

37

Start codon is on... (DNA or RNA?)

38

Start codon is usually...

39

Stop codons do what?

40

There are 3 stop codons:

34

A DNA sequence where RNA polymerase (and factors) bind to start transcription.

33

False.

36

A sequence that signals transcription to stop.

35

False (usually).

38

AUG (codes for methionine).

37

mRNA (codon).

40

UAA, UAG, UGA.

39

Tell the ribosome to stop translation (no amino acid).

41

Trap: a stop codon codes for a special
'stop amino acid'. True or false?

42

Reading frame means...

43

Why is AUG a big deal beyond 'start'?

44

If you see a DNA sequence and they
ask for mRNA, the fastest method is:

45

Quick check: if a DNA strand is labeled 5'-
>3' and it's the template, the mRNA will be...

46

Polymerases {{c1::synthesize}} nucleic acids
5'->3' by adding to the {{c2::3'}} end.

47

In transcription: mRNA is complementary
to the {{c1::template}} strand and
matches the {{c2::coding}} strand (T⁻>U).

48

Start codon (standard):

42

How you group bases into codons (triplets) starting from a start point.

41

False.

44

Find the coding strand and swap T -> U (or complement the template).

43

It sets the reading frame.

46

Polymerases synthesize nucleic acids 5'->3' by adding to the 3' end.

45

Complementary and antiparallel (so read the template 3'->5').

48

AUG

47

In transcription: mRNA is complementary to the template strand and matches the coding strand (T->U).

49

How many bases in one codon?

50

Main enzyme for transcription is...

51

RNA polymerase uses what building blocks?

52

Transcription makes RNA from a...

53

In eukaryotes, transcription
needs help from... (broad term)

54

What is a transcription factor (in plain words)?

55

Transcription starts at the...

56

Transcription ends at a...

50

RNA polymerase.

49

3

52

DNA template.

51

Ribonucleotides (ATP, UTP, CTP, GTP).

54

A protein that helps control
transcription by binding DNA.

53

Transcription factors.

56

Terminator / termination signal.

55

Promoter region (DNA).

57

Eukaryotes separate transcription
and translation because...

58

Prokaryotes can start translating an mRNA
while it's still being transcribed because...

59

In eukaryotes, the first RNA made
from a protein-coding gene is called...

60

3 main processing steps for eukaryotic pre-mRNA:

61

5' cap does what? (high-level)

62

Poly-A tail does what? (high-level)

63

Trap: poly-A tail is copied directly from
a DNA stretch of T's. True or false?

64

Splicing means...

58

They don't have a nucleus.

57

Transcription is in the nucleus;
translation is in the cytoplasm.

60

5' cap, splicing, poly-A tail.

59

pre-mRNA (primary transcript).

62

Helps mRNA stability and export;
affects translation efficiency.

61

Protects mRNA and helps
ribosome bind/start translation.

64

Removing introns and joining exons together.

63

False (the tail is added).

65

Introns vs exons: which are
usually kept in mature mRNA?

66

Trap: introns are translated
into protein. True or false?

67

Alternative splicing is useful because...

68

Where does mRNA splicing happen (eukaryotes)?

69

After processing, mRNA must
leave the nucleus through...

70

RNA polymerase reads the DNA
template strand in which direction?

71

If the coding DNA strand is 5'-
ATG GAA TTT-3', the mRNA is...

72

If you're given the template DNA strand
and asked for mRNA, what must you do?

66

False (normally).

65

Exons.

68

In the nucleus.

67

One gene can make multiple protein variants.

70

3' -> 5'.

69

Nuclear pores.

72

Complement it AND reverse
direction to write mRNA 5'->3'.

71

5'-AUG GAA UUU-3'.

73

Transcription uses base pairing rules, but the output is...

74

RNA polymerase makes a single RNA from a DNA region called a...

75

In eukaryotes, mRNA is usually...
(one gene -> one mRNA)

76

In prokaryotes, an mRNA can be...

77

Operon (basic meaning) is...

78

Trap: splicing is a normal step for prokaryotic mRNA. True or false?

79

If a question mentions 'TATA box' or many transcription factors, think...

80

RNA polymerase vs ribosome: who does what?

74

Gene (transcription unit).

73

RNA, so it uses U instead of T.

76

Polycistronic (can code for multiple proteins).

75

Monocistronic (one mRNA codes for one protein).

78

False (in basic pre-med level).

77

A cluster of genes controlled together by
one promoter (common in prokaryotes).

80

RNA polymerase makes RNA;
ribosome makes protein.

79

Eukaryotic transcription.

81

If you see 'nucleus' in a gene-expression question, your first thought should be...

82

Eukaryotic pre-mRNA processing: {{c1::5' cap}} + {{c2::splicing}} + {{c3::poly-A tail}}.

83

Splicing removes {{c1::introns}} and joins {{c2::exons}}.

84

Prokaryotes can couple transcription and translation because they have no {{c1::nucleus}}.

85

Process that removes introns from pre-mRNA:

86

Enzyme that makes RNA from DNA:

87

Translation happens on...

88

Ribosomes are made of...

82

Eukaryotic pre-mRNA processing:
5' cap + splicing + poly-A tail.

81

Transcription and RNA processing.

84

Prokaryotes can couple transcription and
translation because they have no nucleus.

83

Splicing removes introns and joins exons.

86

RNA polymerase

85

Splicing

88

rRNA and proteins.

87

Ribosomes.

89

Ribosome reads the mRNA in which direction?

90

The polypeptide chain grows in which direction?

91

Start codon does two things: it says 'start' and it...

92

Which RNA carries amino acids?

93

Which RNA carries the message?

94

Which RNA is the main
structural/catalytic part of ribosomes?

95

tRNA is 'charged' when it...

96

The enzyme that attaches
an amino acid to tRNA is...

90

From N-terminus to C-terminus.

89

5' -> 3'.

92

tRNA.

91

Sets the reading frame.

94

rRNA.

93

mRNA.

96

Aminoacyl-tRNA synthetase.

95

Has an amino acid attached.

97

Why is aminoacyl-tRNA synthetase so important?

98

Stop codons are recognized by...

99

A site, P site, E site: A stands for...

100

A site, P site, E site: P stands for...

101

A site, P site, E site: E stands for...

102

Peptide bond formation is catalyzed mainly by...

103

Translation has 3 big stages:

104

Initiation (eukaryotes) needs
the... to bind the mRNA.

98

Release factors (not tRNA).

97

Because it ensures the correct amino acid matches the codon (via tRNA).

100

Peptidyl site (holds the growing chain).

99

Aminoacyl site (incoming tRNA).

102

rRNA in the ribosome
(peptidyl transferase activity).

101

Exit site (empty tRNA leaves).

104

5' cap (helps ribosome bind).

103

Initiation, elongation, termination.

105

Prokaryotes don't use a 5'
cap for initiation because...

106

Polyribosome (polysome) means...

107

If you want to speed up protein production
from an mRNA, one way is to...

108

Rough ER vs free ribosomes:
what's the key difference?

109

What tells a ribosome to go to rough ER?

110

After translation, proteins often need...

111

Chaperone proteins (high-level) help with...

112

A mutation that changes a codon
can change the protein because...

106

Many ribosomes translating
the same mRNA at once.

105

They don't cap their mRNA the same way (basic).

108

RER ribosomes make proteins
for secretion/membranes; free
ribosomes make cytosolic proteins.

107

Use more ribosomes on it (polysomes).

110

Folding (and sometimes modification/targeting).

109

A signal peptide on the new protein.

112

It can change the amino acid sequence
(and therefore folding/function).

111

Proper protein folding and preventing misfolding.

113

Ribosome reads mRNA {{c1::5'->3'}}; protein grows {{c2::N->C}}.

114

Stop codons (RNA): {{c1::UAA}}, {{c2::UAG}}, {{c3::UGA}}.

115

Codon is on {{c1::mRNA}}; anticodon is on {{c2::tRNA}}.

116

Direction ribosome reads mRNA:

117

Direction a protein chain grows:

118

Ribosome has two main subunits:

119

During elongation, the new tRNA enters the... site first.

120

After a peptide bond forms, the growing chain is now on the tRNA in the...

114

Stop codons (RNA): UAA, UAG, UGA.

113

Ribosome reads mRNA 5'->3'; protein grows N->C.

116

5' to 3'

115

Codon is on mRNA; anticodon is on tRNA.

118

Small subunit (binds mRNA) + large subunit (forms peptide bonds).

117

N-terminus to C-terminus

120

A site (then it shifts).

119

A site.

121

Translocation means...

122

After translocation, the tRNA
that was in the A site moves to...

123

After translocation, the empty tRNA
that was in the P site moves to...

124

Translation needs energy. The
high-level 'fuel' used is...

125

Trap: the ribosome chooses the correct amino acid
by reading the amino acid itself. True or false?

126

If the start codon is mutated,
what's a likely outcome?

127

Stop codon mutation (stop -
> sense) usually causes...

128

The genetic code is read in a continuous,
non-overlapping way. That means...

122

P site.

121

The ribosome moves one
codon forward on the mRNA.

124

GTP (and ATP for tRNA charging).

123

E site and exits.

126

Translation may not start (or starts at a
different AUG), changing the whole protein.

125

False.

128

Each base is part of one codon
only (no 'sharing' between codons).

127

A longer protein (read-through)
until the next stop codon.

129

How many possible codons are there?

130

How many codons are stop codons?

131

So how many codons code for amino acids?

132

The genetic code is 'nearly universal' meaning...

133

Trap: codon charts use DNA
triplets with T. True or false?

134

If you are given a DNA coding strand
triplet like ATG, the mRNA codon is...

135

If you are given a DNA template
triplet like TAC, the mRNA codon is...

136

Wobble (high-level) means...

130

3.

129

64 (4^3).

132

Most organisms use the same
codon -> amino acid meanings.

131

61.

134

AUG.

133

False (they usually show mRNA codons with U).

136

One tRNA can recognize more than one
codon (often differing at the 3rd base).

135

AUG.

137

Why are silent mutations common at the 3rd base of a codon?

138

Degeneracy of the code can be protective because...

139

But degeneracy does NOT mean mutations are harmless because...

140

Trap: AUG is the only codon for methionine in standard code. True?

141

If a codon changes to a stop codon, the mutation type is...

142

Total number of codons:

143

Number of stop codons:

144

Codon tables are usually for {{c1::mRNA}} codons (use {{c2::U}} not T).

138

Some mutations don't change
the amino acid (silent).

137

Because of degeneracy/wobble: many
amino acids allow a different 3rd base
without changing the amino acid.

140

True (standard genetic code).

139

Some changes do change amino
acids, create stops, or shift the frame.

142

64

141

Nonsense mutation.

144

Codon tables are usually for
mRNA codons (use U not T).

143

3

145

Genetic code: {{c1::degenerate}} (many codons -> one amino acid) but not {{c2::ambiguous}} (one codon -> one meaning).

146

Mutation means... (in genetics)

147

Trap: an error in transcription is a mutation. True or false?

148

Trap: an error in translation is a mutation. True or false?

149

Point mutation means...

150

Silent mutation means...

151

Missense mutation means...

152

Nonsense mutation means...

146

A change in the DNA sequence.

145

Genetic code: degenerate (many codons -> one amino acid) but not ambiguous (one codon -> one meaning).

148

False.

147

False (it's usually a transcription error, not a DNA change).

150

DNA change that does NOT change the amino acid.

149

A single-base change (substitution).

152

DNA change that creates a stop codon (early stop).

151

DNA change that changes one amino acid.

153

Frameshift mutation usually comes from...

154

Insertion/deletion of 3 bases
(or 6, 9...) usually causes...

155

Why are frameshifts often
worse than missense mutations?

156

If a mutation happens in a promoter,
the most direct effect is on...

157

If a mutation happens in an enhancer/silencer,
the most direct effect is on...

158

If a mutation happens in an intron (not
at splice sites), the effect is often...

159

Splice-site mutation often causes...

160

If a stop codon is mutated into a
sense codon, the protein becomes...

154

In-frame change: add/remove
amino acids but reading frame stays.

153

Insertion or deletion NOT in multiples of 3.

156

Transcription level (how much mRNA is made).

155

They change every codon
downstream (until a stop).

158

None (but splice-site intron
mutations can be huge).

157

Gene regulation (how much transcription happens).

160

Longer (translation continues until another stop).

159

Incorrect splicing (exon skipping, intron retention).

161

If a sense codon is mutated into a stop codon, the protein becomes...

162

A silent mutation can still matter if it... (high-level)

163

Scenario: a mutation changes one amino acid from nonpolar to charged in the protein core. Likely effect?

164

Scenario: mutation happens near the end of a very long gene. Frameshift vs missense: which is usually less catastrophic?

165

If a mutation occurs in the 5' UTR (untranslated region), it may affect...

166

If a mutation changes the start codon AUG, likely effect is...

167

One gene can produce different proteins without any mutation because of...

168

Mutation types: silent ({{c1::same AA}}), missense ({{c2::different AA}}), nonsense ({{c3::stop codon}}).

162

Affects splicing, mRNA stability,
or translation efficiency.

161

Shorter (premature termination).

164

Missense is usually less catastrophic.

163

Protein folding/function may be disrupted.

166

No translation or wrong start site (wrong protein).

165

Translation efficiency, not the
amino acid sequence directly.

168

Mutation types: silent (same AA), missense
(different AA), nonsense (stop codon).

167

Alternative splicing.

169

Frameshift usually = insertion/deletion
not a multiple of {{c1::3}}.

170

Mutation that creates a premature stop codon:

171

Mutation that shifts the reading frame:

172

Biggest reason prokaryotes
can do faster gene expression:

173

Eukaryotes do NOT couple
transcription and translation because...

174

Eukaryotic mRNA is typically...
(one protein per mRNA)

175

Prokaryotic mRNA is often... (operons)

176

Eukaryotic pre-mRNA has... and must be...

170

Nonsense mutation

169

Frameshift usually =
insertion/deletion not a multiple of 3.

172

No nucleus -> transcription
and translation can be coupled.

171

Frameshift mutation

174

Monocistronic.

173

mRNA must be processed and
exported from the nucleus first.

176

Introns; spliced.

175

Polycistronic.

177

Prokaryotic mRNA usually has...

178

Ribosome size: prokaryotes have... and eukaryotes have...

179

Trap: 70S is bigger than 80S because 70>80 is false anyway, but still...

180

Where are ribosomes found in eukaryotic cells? (2 places)

181

Where are ribosomes found in prokaryotic cells?

182

If a question mentions 'splicing' or '5' cap', it's almost always...

183

If a question mentions 'operon' or 'polycistronic mRNA', it's almost always...

184

Prokaryotic transcription initiation often uses a...

178

70S; 80S.

177

Few/no introns and no classic splicing.

180

Free in cytosol and bound to rough ER.

179

70S is smaller than 80S.

182

Eukaryotes.

181

In the cytoplasm (no ER).

184

Sigma factor (basic idea).

183

Prokaryotes.

185

In eukaryotes, mRNA is made mainly by... (optional detail)

186

Prokaryotes: transcription and translation can be {{c1::coupled}}. Eukaryotes: they're {{c2::separated}} by the nucleus.

187

Ribosome size in bacteria:

188

Ribosome size in eukaryotic cytosol:

189

Why don't cells just express every gene all the time?

190

Biggest control point for gene expression (high-level) is often...

191

Upregulation means...

192

Downregulation means...

186

Prokaryotes: transcription and translation can be coupled. Eukaryotes: they're separated by the nucleus.

185

RNA polymerase II.

188

80S

187

70S

190

Transcription initiation.

189

Wasteful and sometimes harmful. Cells only make what they need.

192

Decrease gene expression (less mRNA/protein).

191

Increase gene expression (more mRNA/protein).

193

Enhancers are DNA regions that...

194

Silencers are DNA regions that...

195

Epigenetics (basic meaning) is...

196

DNA methylation usually makes transcription...

197

Histone acetylation usually makes transcription...

198

mRNA stability matters because...

199

microRNA (miRNA) high-level job is to...

200

Post-translational modification means...

194

Decrease transcription when
bound by repressor proteins.

193

Increase transcription when
bound by activator proteins.

196

Lower (gene silencing).

195

Changes in gene activity without
changing the DNA sequence.

198

More stable mRNA lasts longer ->
more protein can be made from it.

197

Higher (DNA more open/accessible).

200

Changing a protein after it's made
(ex: phosphorylation, glycosylation).

199

Reduce gene expression by blocking
translation or promoting mRNA breakdown.

201

Phosphorylation usually means...

202

Protein targeting signals matter because...

203

Regulation can happen at: {{c1::transcription}},
{{c2::RNA processing}}, {{c3::translation}},
and {{c4::post-translation}}.

204

Central dogma is a rule of thumb, not
a law. Biggest famous exception is...

205

Reverse transcriptase is an
enzyme that makes... from...

206

RNA viruses often need an enzyme called...

207

Prions are...

208

Trap: reverse transcription is the
same as transcription. True or false?

202

A protein needs to end up
in the correct place to work.

201

Adding a phosphate group to a
protein to change its activity.

204

Reverse transcription (RNA -
> DNA) in retroviruses.

203

Regulation can happen at: transcription, RNA
processing, translation, and post-translation.

206

RNA-dependent RNA polymerase.

205

DNA from RNA.

208

False.

207

Infectious proteins (no DNA or RNA).

209

DNA -> DNA is called...

210

Transcription: DNA -> {{c1::RNA}}. Reverse transcription: RNA -> {{c2::DNA}}.

211

Enzyme used by retroviruses to make DNA from RNA:

210

Transcription: DNA -> RNA.
Reverse transcription: RNA -> DNA.

209

Replication.

211

Reverse transcriptase